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RESEARCH ARTICLE

Behavior, ecology and territory of the chestnut-bellied hummingbird, *Saucerottia castaneiventris*, in the xerophytic vegetation of the Chicamocha canyon of Colombia

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Abstract

The Chestnut-bellied Hummingbird *Saucerottia castaneiventris* is an endemic hummingbird of Colombia, currently categorized as Near Threatened (NT) globally and as Vulnerable (VU) in Colombia. We characterize the territorial defense and foraging behaviors of *S. castaneiventris* hummingbird during different seasons of the year, and we determined the size of the *S. castaneiventris* territory and its relationship with floral abundance at different times of the year. We made four field trips between 2008 and 2009 and registered 19 individuals from *S. castaneiventris*. Of these, 10 were in the rainy periods, distributed in five territories (one male and one female for each). Eight were in the dry period (July), distributed in four territories. And one individual was in the dry period of February, which did not settle in any of the identified territories. Territorial defense occupied a large part of species' time. The nectar drinking, and insect hunting were the most frequent activities. The most common

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floral resources were *Opuntia dillenii*, *Tillandsia* sp. and *Aloe vera*. The hummingbirds *Chlorostilbon gibsoni* and *Doryfera ludoviciae* shared habitats with *S. castaneiventris* and there were fluctuations in encounter rates between the seasons (*C. gibsoni* ER: 20–7.5 and *D. ludoviciae* and ER: 0.0–2.5). Territories ranged between 1800 and 3800 m^2 for the dry season and between 1500 and 6500 m^2 for the rainy season. Our results provided primary information on the ecology of *S. castaneiventris* and form the basis for the formulation of conservation strategies for the species and for its habitats..

Keywords
Agonistic behavior, foraging, interspecific relationships, territorial behavior, threatened species

Introduction

The general behavior and territoriality of hummingbirds can be influenced by factors such as the quantity and quality of resources and by the presence and density of competitors (Norton et al. 1982; Temeles et al. 2006). These factors influence the size of the territories and the ecology of the species (Norton et al. 1982; Justino et al. 2012). They act in synergy and cause a reduction in the availability of resources with the consequent increase in the extent of the territories (Hixon 1980; Eberhard and Ewald 1994).

Colombia contains more species of hummingbirds than any other country in the world (185 species, Ayerbe-Quiñones 2018), with many endemic species (37, e.g. *Saucerottia castaneiventris*). However, despite the high richness, information gaps for many species remain, mainly on behavior and territoriality (Stiles and Wolf 1970; Márquez-Luna et al. 2018). The Chestnut-bellied Hummingbird *Saucerottia castaneiventris*, is one of the 37 hummingbird species in Colombia that have restricted distributions of less than 50,000 km^2 (Hernández et al. 1992; Hilty and Brown 2009). This hummingbird has scattered records in the middle basin of the Chicamocha river between the departments of Santander and Boyacá on the western slope of the Eastern Cordillera of the Colombian Andes as well as in the foothills of the San Lucas mountain range west of the Magdalena River (Schuchmann 1999) and in the municipality of Villa de Leyva, Boyacá (Lopez-Lanus 2002). During the 2000's our knowledge of aspects of the species' distribution and ecology increased (Parra et al. 2006; Cortés-Herrera 2006; Cortés-Herrera et al. 2016, Renjifo et al. 2016). However, key aspects of the species' behavior, territoriality, and other characteristics are still unknown.

Saucerottia castaneiventris is distributed in the xerophytic and dry enclaves of the Chicamocha river canyon in the Colombian Andes, in the departments of Santander and Boyacá. Additionally, there is a record in the humid forests of the San Lucas mountain range, an extension of the Central Andes (Renjifo et al. 2016). The species is currently categorized as Near Threatened (NT) globally (BirdLife International 2020) and as Vulnerable (VU) in Colombia (Renjifo et al. 2016). Nevertheless, specific behavior and foraging information remain understudied or undocumented. For instance, territorial defense with other humming-

birds or maintaining territories across the year would be an aspect of the natural history of the species, which would contribute to assessing its vulnerability in its highly transformed habitats, and the documentation of conservation strategies in its area of distribution.

We compared territorial and feeding behaviors of *S. castaneiventris* during different rainy seasons in the natural reserve Reserva Natural de Aves Cucarachero del Chicamocha in the Colombian Andes. Our objectives were to: 1) characterize the territorial defense and foraging behaviors of *Saucerottia castaneiventris* during different rainy seasons throughout the year; 2) provide a preliminarily evaluation of the species' competitive ability during the dry and rainy seasons throughout the year; and 3) determine the territory size of *S. castaneiventris* and its relationship to floral abundance during different times of the year. We start from the premise that *S. castaneiventris* will exhibit territorial behaviors marked as surveillance from percha sites, routes through the territory, disputes with other species, as has been documented for species of the subfamily Trochilinae (Arizmendi and Ornelas 1990; Ornelas 1995). Likewise, the size of the territory will be positively related to the abundance of the floral resource.

Materials and methods

Study area

Our research was carried out in the natural reserve Aves Cucarachero del Chicamocha located in the municipality of Zapatoca-Santander in northeastern Colombia, at an elevation of 763 m a.s.l. at the confluence of the Suárez and Chicamocha rivers (06°48'59"N, 073°12'47"W (DMS), Fig. 1). The reserve has an area of 1400 ha. The main vegetation is made up of thickets and tropical dry forest, dominated by the tree species *Pithecellobium dulce*, *Prosopis juliflora*, *Cerdium praecox*, *Bursera graveolens* and the cacti *Stenocereus* sp., *Armetocereus humilis*, *Opuntia elatior*, *O. dillenii*, and *O. tunicata* (Hernández and Sánchez 1992).

The study area has a Bimodal precipitation, with two rainy periods and two dry periods in the year. The rainy periods are April and May and a second period between August and November, with mean precipitation of 634 mm. The dry period is from December to February and between June and July, with mean precipitation of 180.8 mm. The annual temperature is 26.3 °C (Albesiano et al. 2003).

Research design and sampling

We made five field trips between October 2008 and July 2009, two during the rainy periods (October and April) and two in dry periods (February and July). In October 2008, we surveyed the area and located a population of *S. castaneiventris* and identified seven territories that the species occupied in the study area; in which we developed the other field trips.

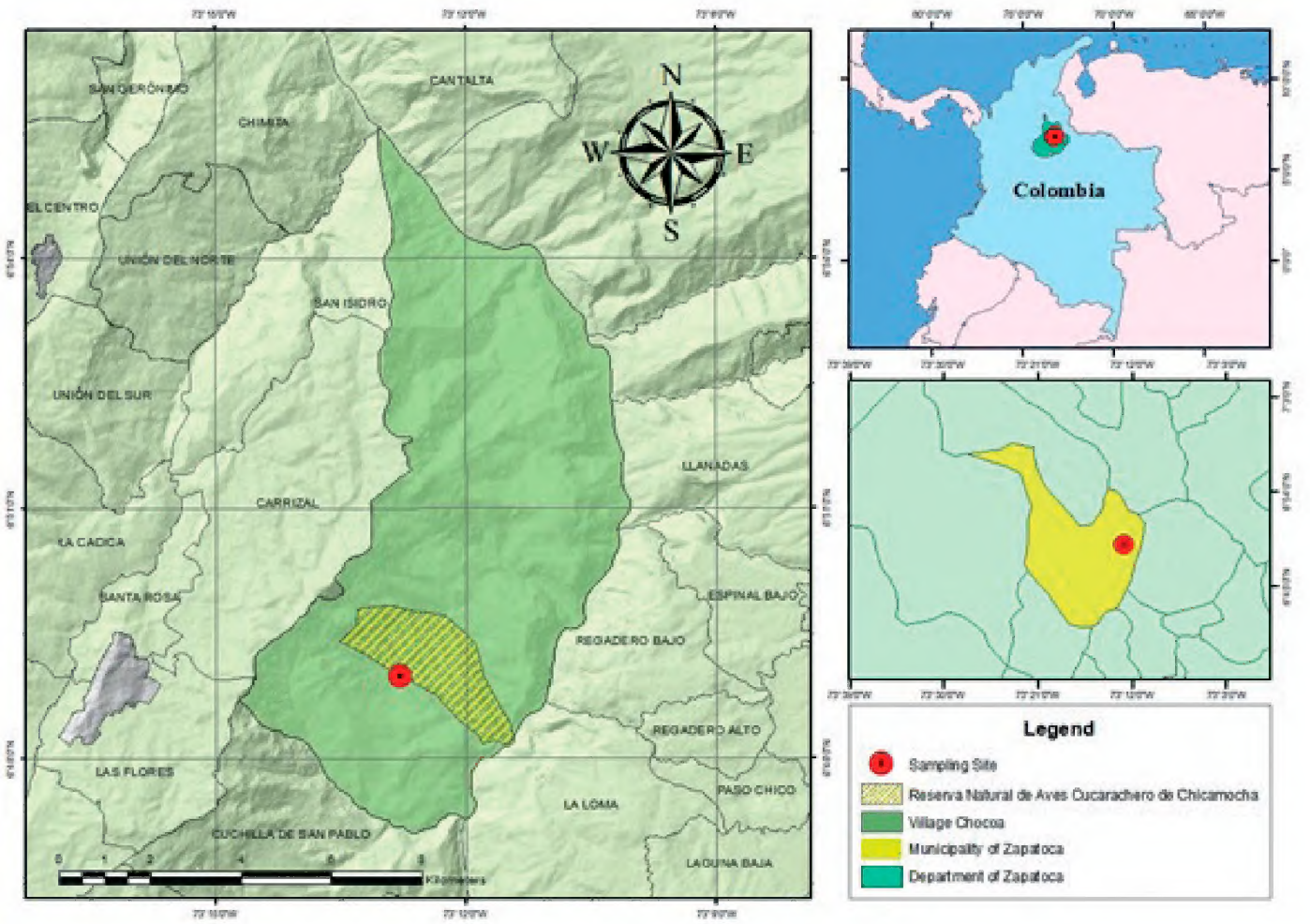

Figure 1. Study area at Reserva Natural de Aves Cucarachero del Chicamocha, in Zapatoca-Santander, northeastern Colombia.

To describe the behavior of *S. castaneiventris*, we made direct observations daily of one hour for three days in each territory. The behaviors are grouped into two categories: 1. territorial defense, through the measurement of a set of agonistic behaviors (Table 1) and 2. Foraging. In the first, the time (minutes and seconds) that the individual spent on each activity and the frequency (the number of times that a bird carried out an action) in activities such as using a perch, singing, complaints or protests, and fighting, were calculated. In the second category, the time and frequency for hunting insects and nectar drinking were registered (Table 1).

To determine interspecific relationships of *S. castaneiventris* with other hummingbirds we established two 3 km transects, separated from each other by 500 m (Cárdenas et al. 2006). The length of the transects was given by the topography of the study area with steep slopes and to cover the greatest amount of habitat given the low abundances of the species in the study area. An observer traversed a transect at a constant speed of 1 km per hour between 06:00 and 10:00, corresponding to the period of activity of hummingbirds in the study area (Peñuela-Díaz, pers. obs.). Abundance data were registered from each hummingbird species that accessed the *S. castaneiventris* territory, including the use of flower resources, and the presence and description of confrontations.

To calculate the size of the territory, we followed an individual within a previously identified territory. The territorial characteristics of the genus *Saucerottia* in accordance

Table 1. Definition of the categories and behavioral postures of *S. castaneiventris* in the Reserva Natural del Ave Cucarachera de Chicamocha, in Zapatoca-Santander, northeastern Colombia.

Category	Behavior	Description
Territorial Defense	Perch	Place in a tree or branch from which the hummingbird protects its floral resources and observes other species of hummingbirds that can enter its territory.
	Singing	Simple repetitions of one or more short notes that can be constantly emitted over time and whose purpose is to keep competitors out of its territories (Stiles 1982).
	Protest Singing	Strong trill of short duration, which is related to intra- and interspecific confrontations or when another hummingbird enters its territory (Reinhardt 2001).
	Confrontations	Intra- and interspecific aggression within the territories; these occurred because other individuals of the same species try to access the available resources. *S. castaneiventris.*
Foraging	Insect Hunting	Duration in which the hummingbird flies or uses some strategy to catch insects.
	Nectar Drinking	Hummingbird access to floral resources.

with the territorial roles described by Feinsinger and Colwell (1978) facilitated observations since a single male or female individual defends the territory in a determined floral patch (Stiles 1975). These points corresponded to the vertex or limit of the territory. We marked each point differentially between the periods to identify variations in the sizes of the territory. The location of the main perch was identified and marked as a reference for tracking the hummingbird's daily activities within its territory.

In each of the territories, we counted the number of flowers and inflorescences potentially used as food by *S. castaneiventris* (Stang et al. 2006). We took samples of the flowers and inflorescences, deposited them in flasks with 70% alcohol and identified them with the purpose of counting, with a base line, the ornithophilous species in the study area.

Analysis of data

Using the observed behavioral postures and their frequency and duration, an ethogram was defined (Valderrama 2005). The ethogram showed the percentage of time spent in each activity (Calviño 2006). Descriptive and central tendency analyses (average and standard deviation) by periods (rainy and dry) were carried out for each behavioral category. To evaluate whether there were statistically significant differences between climatic periods and behavioral frequency we used a Mann-Whitney test in the SPSS Statistics 17.0 statistical program. We schematized the data through a Box Plot and a frequency histogram.

We determined the encounter rate of hummingbird species in the *S. castaneiventris* territories between the periods (rainy and dry), taking the number of observed individuals and dividing them by the total number of sampling hours multiplied by 10 (encounter rate in 10 hours of observation) (Bibby et al. 1998). We used relative

abundance values to reduce errors of over- or underestimation of the real number of individuals, given the detection capacity of the researchers in the study area.

$$\text{Encounter Rate} = \frac{\text{Total Individuals by species}}{\text{Total hours of observation}} \times 10 \text{ hours}$$

Each species was categorized according to its abundance as Rare <3 individuals; Uncommon >3–10; Common >10–20 and Abundant >20.

We estimated the area of the *S. castaneiventris* territory, from the use of the longitude (x) and latitude (y) coordinates in the ARCGIS 9.2 program and its extensions Hawth´s Tools and Kernel density estimate (KDE). With this procedure we find the convex polygon of the territories for each period (rainy and dry). To determine if there were statistically significant differences between the sizes of the territories in the different climatic periods, we performed a Kruskall-Wallis test.

Results

General aspects of the population

We obtained records of 19 individuals from *S. castaneiventris*. Of these, 10 were in the rainy periods, distributed in five territories (one male and one female for each). Eight were in the dry period (July), distributed in four territories. And one individual was in the dry period of February, which did not settle in any of the identified territories.

Saucerottia castaneiventris behavior

We observed *S. castaneiventris* doing surveillance of the territory from exposed perches. Individuals spent 32% of their time in this activity during the dry periods and 37.2% during the rainy periods, with a frequency of 198 and 265 times for the dry and rainy periods, respectively. Simultaneous to perching, the hummingbirds made calls and call songs with time percentages of 0.6% and 0.7% for both seasons and with a frequency of 136 and 173 for the dry period, and 169 and 27 during the rainy periods. The hummingbirds were observed to generally engage with one another close to perches and blooming patches. We observed, on several occasions, intense intraspecific confrontations to the point of falling to the ground and fighting for several seconds. The birds carried out an average of 28 intra- and interspecific confrontations for both climatic periods.

During foraging behaviors, nectar drinking was the most frequent activity (129) and the one that accumulated the most time (1.4% average for each occasion) during the dry period, compared to the rainy season where the frequency was 99 times and occupied 0.6% of the time. The most visited floral resources for both seasons were *Opuntia dillenii*, *Tillandsia* sp. and *Aloe vera*. To access the flowers, the hummingbirds used two strategies. The first strategy was to access the resource by hov-

ering and the second was to perch on the flower (Fig. 2). The hummingbirds made legitimate visits for periods of 12 to 15 seconds.

To prey on insects, the birds used plant species from their territory such as *Thevetia peruviana*, *Prosopis* sp., *Melocactus pescaderiensis*, and *Opuntia dillenii*. During both climatic periods, the species accessed the resource in several ways as follows: 1. they made long and short flights to groups of insects in flight. 2. They flew directly to a substrate to catch the food and then returned to their perch. 3. They captured insects flying from their perch with quick movements of the head; and 4. They flew sustained in the air and looked for food among the vegetation. To hunt insects, they used 0.6% of the time with a frequency of 76 times for the dry period and 1.5% of the time with a frequency of 191 times during the rainy periods.

There were no significant differences between the frequencies of the behaviors during the two climatic periods (P = 0.09). However, during the dry period of July, there was an increase in the frequency of territorial defense singing and nectar drinking and during the rainy period the number of occasions in which they hunted insects was higher (Fig. 3). As for the seasonal behaviors, insect hunting showed marked differences between the two climatic periods (P = 0.02); the other behaviors showed no differences (Fig. 3).

Figure 2. Different strategies for nectar drinking used by *S. castaneiventris*. A) Fluttering in flowers of *Tillandsia* sp. B) Perched in *Aloe vera* flowers. Possible competitors of S. *castaneiventris* C) *Doryfera ludoviciae*. Photo: Mauricio Ossa. D) *Chlorostilbon gibsoni*.

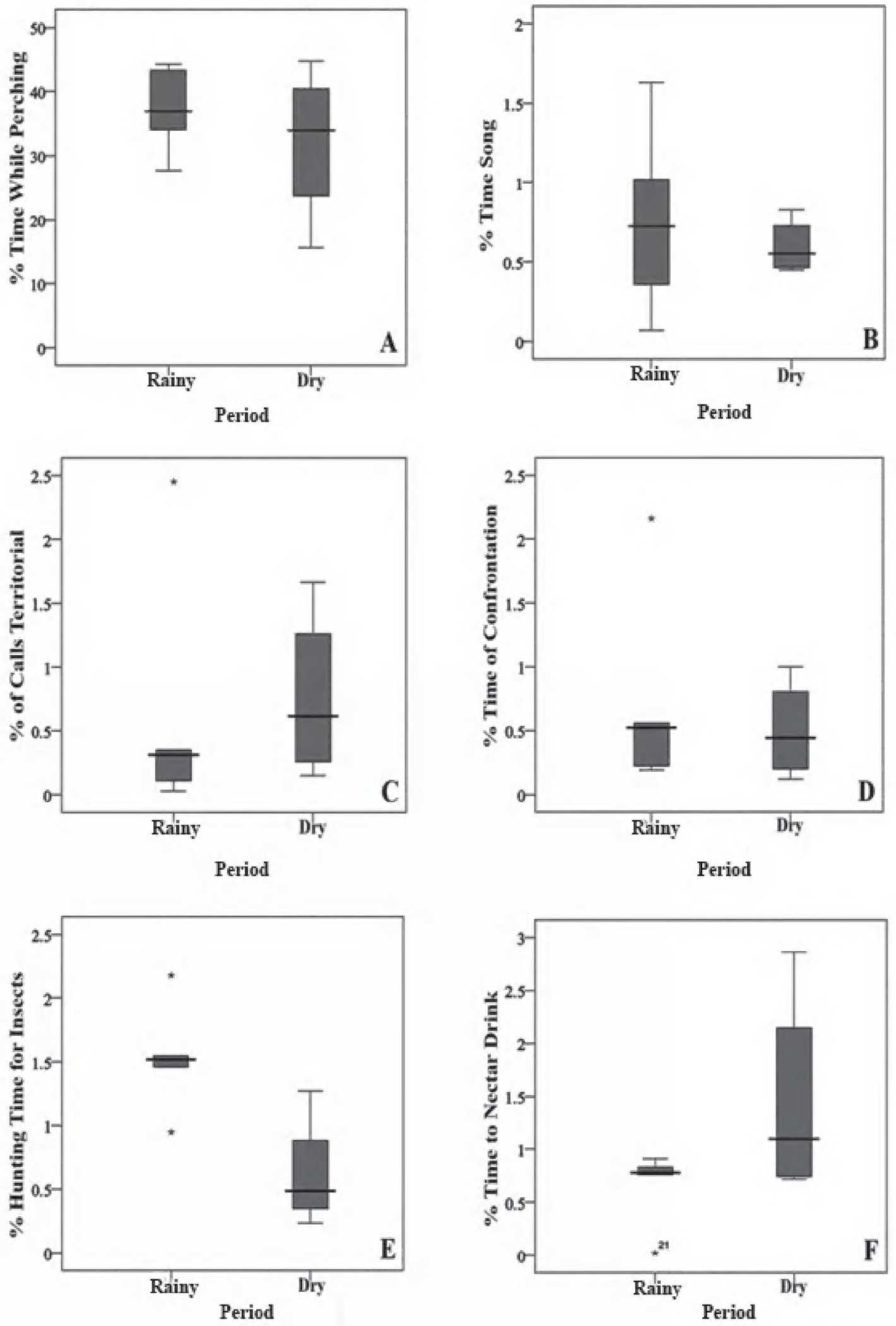

Figure 3. Box diagrams of the percentage of time spent at each *S. castaneiventris* activity during two climatic periods in the Reserva Natural del Ave Cucarachera de Chicamocha, in Zapatoca-Santander, northeastern Colombia.

Co-occurrence of other hummingbirds with *Saucerottia castaneiventris*

Two hummingbird species shared the area with the *S. castaneiventris*: *Chlorostilbon gibsoni* and *Doryfera ludoviciae* (Fig. 2C and D). During the first dry period (February) the species *C. gibsoni* was common (rate of encounter (RE) = 20), and for the second dry period (July) and in the rainy period (April) it was uncommon (RE = 7.5 and RE = 12.5 respectively). In contrast, *Doryfera ludoviciae* was rare and during the dry periods it had an encounter rate of 0 and 2.5 respectively; and during the main rainy season it was uncommon (RE = 2.5). Finally, *S. castaneiventris* was not registered in the first dry period (RE = 0.0) and it was uncommon for the second dry period and rainy period and had encounter rates of 4.5 and 3.75, respectively.

Regarding the use of common resources, *Chlorostilbon gibsoni* made use of floral resources used by *S. castaneiventris* and confrontations were observed close to the plant species that offered the floral resource. No confrontations with *Doryfera ludoviciae* were seen and *S. castaneiventris* only drank nectar from *O. dillenii* flowers (Fig. 4).

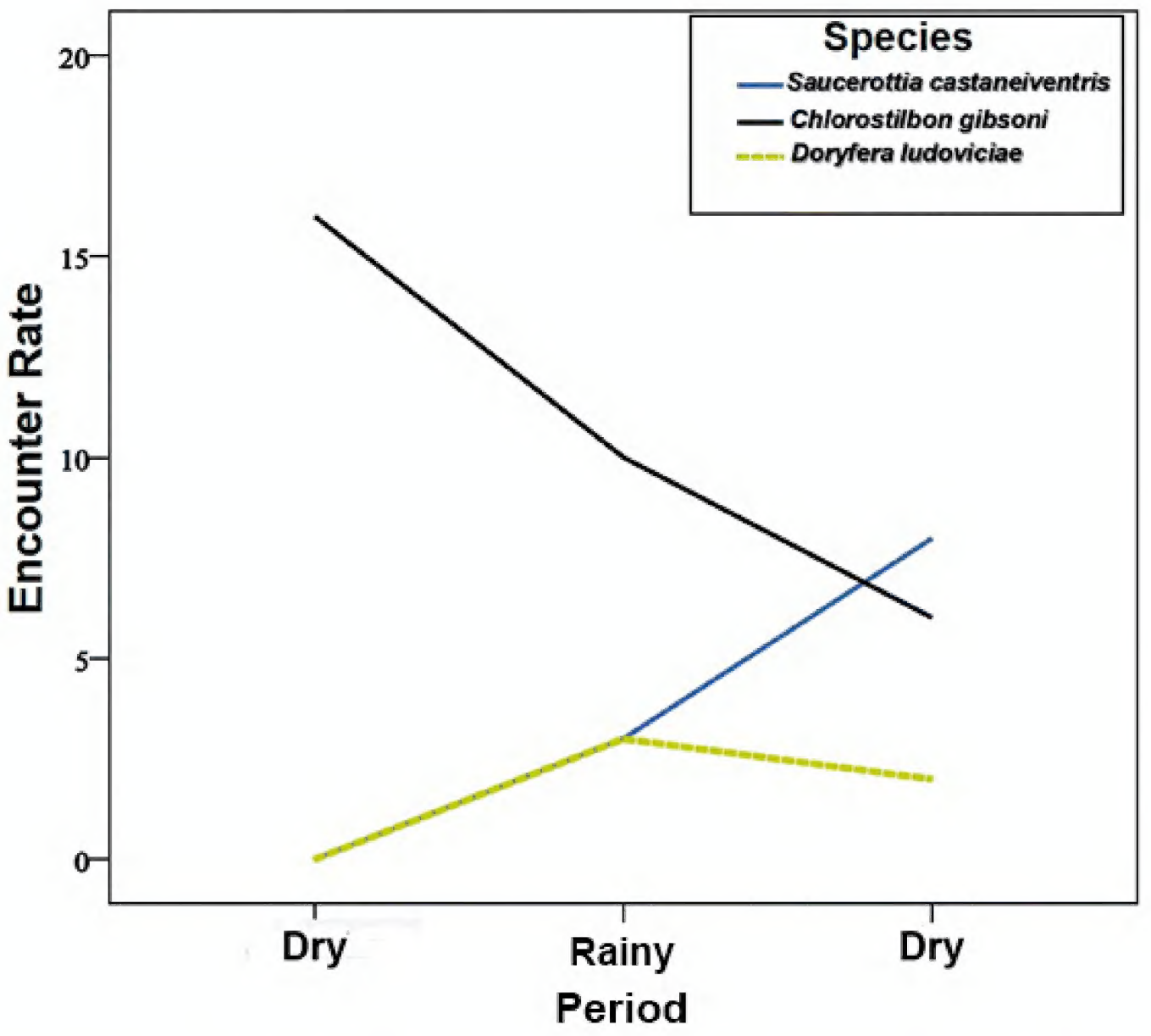

Figure 4. Encounter rate of possible competitors of *S. castaneiventris* during different climatic periods in the Reserva Natural del Ave Cucarachera del Chicamocha, in Zapatoca-Santander, northeastern Colombia.

Reproduction

For the rainy period, an individual of *S. castaneiventris* was observed constructing a nest 3 m high in a *Prosopis juliflora* tree. For the construction of the nest, it used cobwebs extracted from *Ceiba pentandra* (Bombacaceae) and *Thevetia peruviana* (Apocynaceae), *Gossypium* sp (Malvaceae) trees, lichens and goat hair. Nest manufacturing ranged from six to eight days and incubation was 17 days. A few days after hatching, the chicks were preyed upon by an unknown predator.

Territory size

During the first dry period, the area of the territory ranged from between 1800 and 3800 m^2 and for the rainy season it was between 1500 and 6500 m^2 (Fig. 5). There were no significant differences between the seasons ($P = 0.345$, $df = 2$).

During the dry period, the area of the territory was negatively correlated with the density of flowers, while for the rainy periods it was positive. The territories with the largest number of flowers were smaller (Fig. 6).

Discussion

We found abundance values (n = 19 individuals) like those documented in other investigations in the Chicamocha Canyon in Soatá-Boyacá (Cortés et al. 2004; Cortés-Herrera 2006; Parra et al. 2006), for example 25 in 2008 (Cortés- Herrera et al. 2016) and 14 individuals in 2011 (García-Ríos and Angarita-Báez 2011).

Our result suggested that *S. castaneiventris* has small populations (with few individuals) compared to other hummingbird species (Morales-González et al. 2020). This increases the species' vulnerability and negative responses to the threats documented by Renjifo et al. (2016). The presence of *S. castaneiventris* in a certain area is affected by the climatic conditions. The dry season wreaks subsequent effects on the number of flowers, a shorter flowering season (Pizano and García 2014) and the exhaustion of nectar production (Feinsinger 1976). Variables that act as population limiting factors and that trigger possible local migrations or seasonal movements are common in species of the Trochilidae family (Levey and Stiles 1992; Naranjo et al. 2012), although the routes, the patterns, processes, and mechanisms that the species uses for these migrations remain unknown (Cortés-Herrera et al. 2016).

The absence of the species in their territories during the dry season has also been documented in the species' distribution to the south of the Chicamocha River Canyon in Soatá-Boyacá (Cortés-Herrera et al. 2016). All this area has a vegetation cover of forests and xerophytic thickets (Rangel-Ch et al. 1997) that have marked seasonality where more than 70% of the flora loses its foliage and flowering is considerably decreased (Mooney et al. 1996). Although there is no certainty, the hypothesis that the species performs elevational migrations has been suggested (Collazos-González et al. 2020). We propose that the areas of adjacent semi-humid

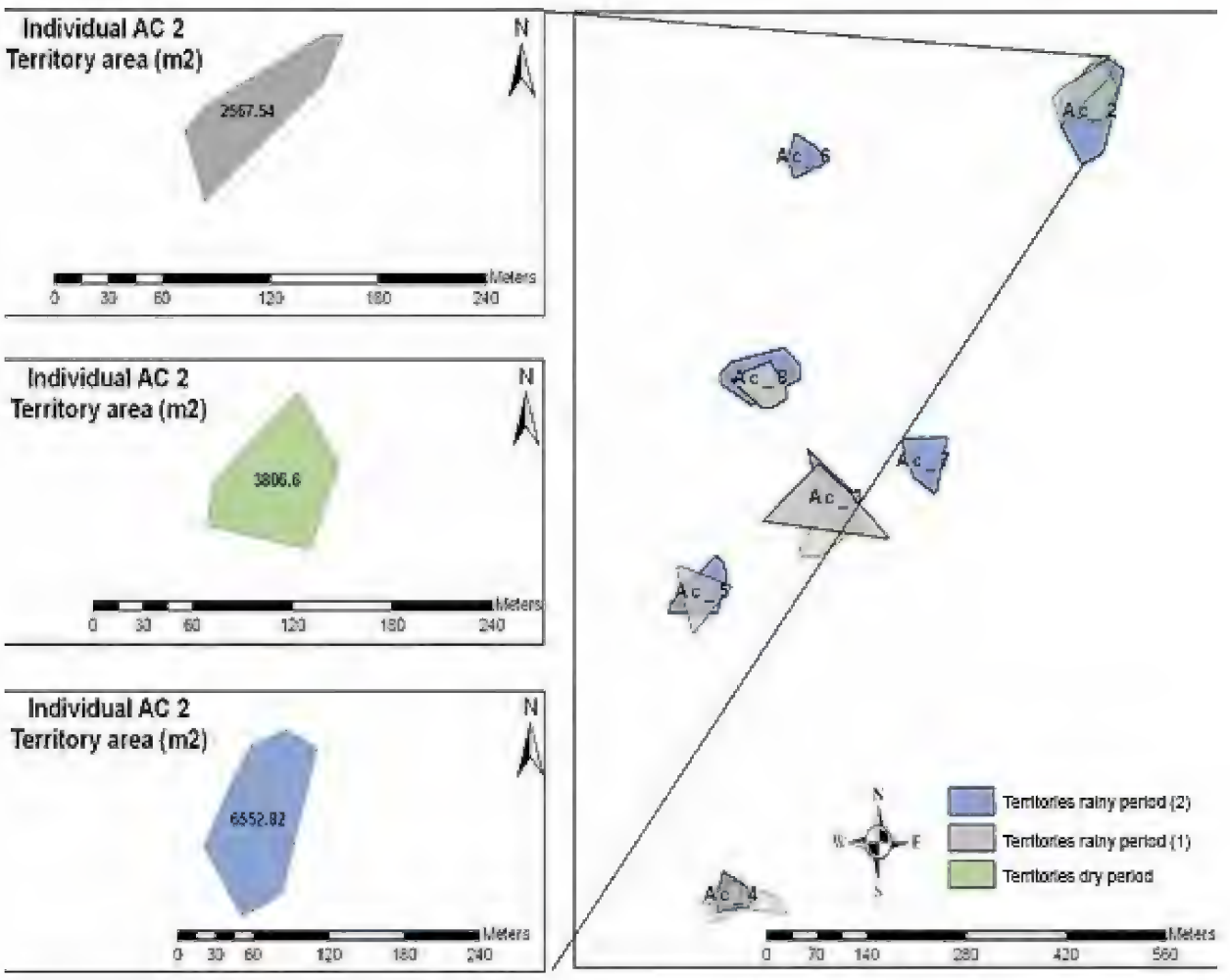

Figure 5. Size of the *S. castaneiventris* territories throughout the seasons (right). Example of areas of the territory of individual no. 2 at different times (left).

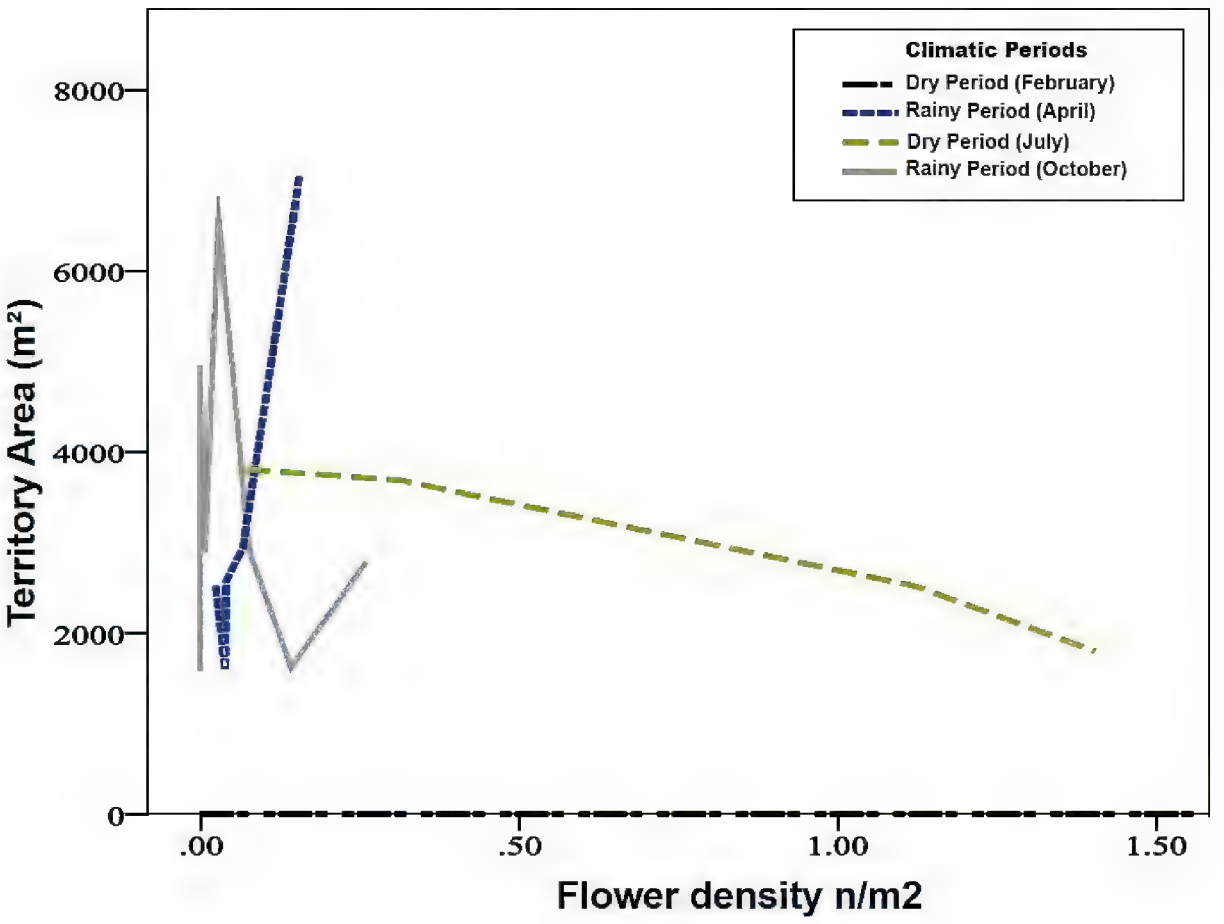

Figure 6. Variation in the size of the territory of *S. castaneiventris* and its relationship with flower density in different climatic seasons.

and humid vegetation at higher elevation play an important role in seasonal movements and offer the hummingbird new flower resources within the elevation gradient that surrounds the Chicamocha Canyon.

Saucerottia castaneiventris behaviors

The different evaluated dimensions of *S. castaneiventris*' behavior such as territorial defense and foraging are shaped, as in many vertebrates, to obtain resources (Márquez-Luna et al. 2018). Specifically, we suggest that the flower density together with the dynamics of the area are limiting factors that generally shape *S. castaneiventris*' behavior.

Territorial defense

The use of a main perch for territorial defense seems to be a common strategy within the territorial species of the Trochilidae family (Trombulak 1990; Melanie et al. 2015). *Saucerottia castaneiventris* strategically chooses its perch in open sites and from where it can easily access floral resources and limit the intrusion of other hummingbirds into the territory. From the perch the hummingbird performs other activities, such as singing, including territorial songs. These have a function directly associated with aggression, domination, and defense of the territories (Cortés-Herrera 2006). The shortest song that occurs is most frequently associated with intraspecific communication and the territorial song, which is a strong trill, is related to intra and interspecific confrontations when another hummingbird enters its territory (Reinhardt 2001). These two songs used by *S. castaneiventris* are an important component for keeping territories free of competitors (Stiles 1982) and they are intended to try to reduce physical contact with other species that could cause injury (Gill and Wolf 1975). An important aspect to assess is the presence of morphological structures (e.g., in the beak), which contribute to the maintenance of territories and guarantee success in disputes with competitors, as documented by Rico-Guevara and Hurme (2019), Rico-Guevara and Araya-Salas (2015).

The constant confrontations that *S. castaneiventris* shows underline the species´ highly territorial behavior, including fighting on the ground, as observed by Gutiérrez and Rojas (2001) for *Agleaectis cupripennis*. These aggressive encounters allow dominance to be established between the two birds because of previous and subsequent fights (Peláez and Baró 1997).

Foraging

Insects were an important prey item in the diet of *S. castaneiventris*, mainly during the rainy season, when insect populations increase due to the rain's arrival (Pizano and García 2014); and the floral resources are not restored from the immediately preced-

ing dry period. Our observations were consistent with the results reported by Cortés-Herrera (2006), where insects of Diptera, Coleoptera, Homoptera and Hymenoptera, form an important component of the diet of *S. castaneiventris*. These are preyed upon in different ways with different strategies that have also been observed in other hummingbird species (Lara and Ornelas 1998; Rico-Guevara 2008; Salamanca 2011).

The increase in flowering during the rainy season is a clear explanation for the increase in this activity at this season. The greater number of flowers can explain the low frequencies of agonistic behaviors observed during the rainy season (Samper 2003). Cortés-Herrera et al. (2016) discuss the species *Trichanthera gigantea*, *Inga codonatha* and *Salvia xeropapillosa* (Cortés-Herrera 2006; Cortés-Herrera et al. 2016) and occasionally *Caesalpina pinnata*, *Erithryna edulis* and *Musa* sp. as the most important floral resources for *S. castaneiventris*. However, these species differ from the preferences observed in our study site for *Opuntia dillenii*, *Tillandsia* sp. and *Aloe vera*. These results suggest that the species takes advantage of the available resources in a differential and opportunistic way in the area where it establishes its populations, as long as they meet the requirements of quantity and quality of nectar (Melendez-Ackerman et al. 1997; García-Ríos and Angarita-Báez 2011). The difference between the shapes and colors of the corollas of the plant species, together with the preferential use at the different points of their distribution, suggests that apparently *S. castaneiventris* does not have a marked preference for any particular type of flowers. In addition, the bird makes efficient use of the resources available in the territories that the species establishes, as if it occurs in other species of the family (Melendez- Ackerman et al. 1997).

A characteristic that the species shows in general is nectar drinking, preferably in grouped flowers (a typical characteristic of territorial hummingbirds, Ramírez et al. 2007) and sustained drinking of a flower. This strategy allows for a lower energy expenditure (Ornelas 1996) and optimizes performance in the changing conditions of the territory that it occupies in the Chicamocha Canyon.

Interspecific relationships of *Saucerottia castaneiventris*

In general, in the seven territories identified in the Chicamocha River Canyon, a low number of species with the potential to compete with *S. castaneiventris* were recorded. In the case of *Doryfera ludoviciae*, its great length of 10.2 cm and its very long beak of 36 mm prevents agonistic confrontations with *S. castaneiventris*. Likewise, its type of foraging along defined routes (Snow and Snow 1980), observed when foraging on *O. dillenii* flowers, could help alleviate the pressures of interspecific competition.

There were aggressive displays and confrontations with *C. gibsoni* that could be considered as a feeding strategy (Stiles and Wolf 1970). The size of *C. gibsoni* is 7.6 cm long with a beak of 13 mm, similar to the morphological measurements of *S. castaneiventris* (Hilty and Brown 2009). Both species make use of the same floral resources; and this could increase interspecific competition, since similar species in

body size have a higher probability of competition (Gutiérrez 2008, López-Segoviano et al. 2017).

Other species as potential competitors of *S. castaneiventris* have been identified in the southern parts of the Chicamocha River Canyon. These include *Saucerottia cyanifrons*, *Chlorostilbon poortmanni* and *Amazilia tzacatl* (Cortés-Herrera 2006). Similarly, there were a greater number of confrontations between *C. poortmanni* that, in ecological terms, could be equivalent to *C. gibsoni* for our study area.

Reproductive annotations on the ecology of *Saucerottia castaneiventris*

Before our breeding record in the month of April and May of *S. castaneiventris*, Cortés-Herrera (2006) mentioned reproductive activity during the months of December and January at Soatá, south of the Chicamocha River Canyon. For both sites, the reproductive stage was observed before the highest flowering peak, indicating that the species could have at least two reproductive seasons, directly linked to the most favorable climatic season for the breeding and raising of its chicks.

Territory

Based on the concepts of spatial use by birds (Tomasevic and Marzluff 2018), a differential use of the different sites was evident in the territory defined by *S. castaneiventris*. This is consistent with the premise that territorial birds establish a central area with elevated use that is generally associated with the particular habitat structure (Adams 2001). In the case of *S. castaneiventris*, easy access to the floral or arthropod resources and an unobstructed perch to protect the territory are the drivers that mark the choice of the central areas for each of the territories. These show a strong dependence on the sizes of the territories between the seasons with these factors, as documented by Hixon et al. (1983) and Temeles (1987); and these have a marked pattern of increased flowering that leads to a decreased territorial area, as occurred during the dry periods. It can be inferred that the owners adjust the size of the territory as a direct response to the availability of food or as a response to the pressures of intrusion by other species (Norton et al. 1982; Eberhard and Ewald 1994).

For the rainy period, the increase in the territory was not related to the density of flowers, but it could be related to the number of intruders, since as the floral resource decreases and the number of competitors increases, the size of the territory shows a tendency to increase (Eberhard and Ewald 1994).

Finally, the use of the same territories after local migrations or seasonal movements suggests a repetitive behavioral strategy for the species, since in 2004 the *S. castaneiventris* species always used the same territories in the Reserva de Aves Cucarachero of Chicamocha (Beltrán Obs. Pers.) southward of the Chicamocha River Canyon (García-Ríos and Angarita-Báez 2011). Although it is not certain if the same individuals arrived during all the seasons sampled in the territories, this

represents an important research topic for understanding the dynamics and the ecological processes and mechanisms that regulate the use of resources, including territories and their structural characteristics as well as their area.

Conservation implications of *Saucerottia castaneiventris*

Due to the loss of habitat caused by colonization together with the cutting and burning of vegetation (Renjifo et al. 2002; Renjifo et al. 2016) and the indiscriminate use of these lands for goat grazing, it is very important to try to conserve remnants of scrub and dry forests of the Chicamocha Canyon. This is vital for the survival of *Saucerottia castaneiventris* and many other species associated with these habitats, such as the Niceforo's Wren *Thryothorus nicefori*.

Knowing the detailed migration routes, aspects of territoriality of males and females, and details of the reproductive ecology of the species, will provide the natural history information which would support the correct management of habitats and of the species itself. This should help mitigate the population decline and maintenance of the birds' habitats, which in Colombia is one of the most threatened plant habitats (Renjifo et al. 2016).

Conclusions

Our contribution is the first complete approach to knowledge of *Saucerottia castaneiventris* as an endemic and highly threatened species in one of the most vulnerable ecosystems in Colombia and the Neotropics. A small number of individuals was recognized. Hence this categorizes it as an elusive species which gives rise to new hypotheses about its population dynamics and the patterns that the emergent properties of its populations follow. It is evident that the vulnerability of the species could increase given the sites chosen for its territories in the xerophytic thickets of the Chicamocha Canyon, which are intensively used by local inhabitants.

We recognized key aspects of the ecology of the species relating to interspecific interactions and reproduction which, in contrast to other species, occurs in different months. Different reproductive seasons depend on what area the species is in and seem to be highly related to the availability of resources. Similarly, the availability of resources seems to be the factor that triggers the migration of the species in the dry period along the Chicamocha canyon and also the dynamics that *Saucerottia castaneiventris* follows throughout the annual cycle in relation to the expansion or reduction of the sizes of their territories.

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